INVESTOR IN PEOPLE

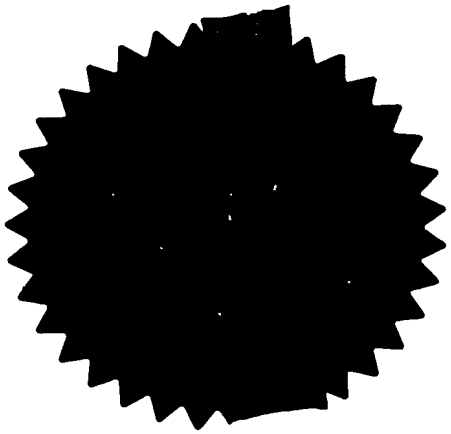
The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed

Dated 31 August 2004

THE PATENT OFFICE
13 DEC 2002
RECEIVED BY FAX

Patents Form 1/77
Patents Act 1977
(Rule 16)

The Patent Office

13DEC02 E770703-1 D10118
P01/7700 0.00-0229046.8

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference: 01013.0327.00GB00

2. Patent application number *(The Patent Office will fill in this part)*: 0229046.8 — 13 DEC 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*:
Bombardier Transportation GmbH
Saatwinkler Damm 43
13627 Berlin
Germany

Patents ADP number *(if you know it)*: 83 16760 4001

If the applicant is a corporate body, give the country/state of its incorporation: Germany

4. Title of the invention: WHEEL SET GUIDANCE ASSEMBLY

5. Name of your agent *(if you have one)*:
Nicl J. AKERS

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*:
Howrey Simon Arnold & White
CityPoint
One Ropemaker Street
London EC2Y 9HS

Patents ADP number *(if you know it)*: 81602 85001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)): YES

Patents Form 1/77

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	7
Claim(s)	3
Abstract	1
Drawing(s)	2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	Fee Sheet, Cover Letter

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 13th December, 2002

12. Name and daytime telephone number of person to contact in the United Kingdom: Noel J AKERS 0207 628 3303

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

WHEEL SET GUIDANCE ASSEMBLY

The present invention relates to a wheel set guidance assembly for suspending a wheel set bearing of a wheel set to a bogie frame. The invention further relates to a bogie, in particular a train bogie, comprising such a wheel set guidance assembly and a method for providing a bogie with optimal wheel set guidance.

DE 41 41 463 describes a wheel set guidance assembly for a train bogie in which a coil spring is arranged on top of the wheel set bearing for carrying the bogie frame and in which the wheel set bearing is further attached to the bogie frame by a rigid steering arm longitudinally extending from the wheel set bearing to a console rigidly mounted on the bogie frame. Metal-rubber elements are arranged between the steering arm and the bogie frame guidance console. For the purposes of this specification, the longitudinal, lateral and vertical directions are references to the respective directions relative to the bogie.

DE 43 15 568 describes a wheel set guidance assembly consisting of two coil springs for the vertical suspension and guidance and rubber elements engaging a guidance pin to take over both longitudinal and lateral guidance of the wheel-set.

One problem of the known wheel set guidance assemblies is that they are not easily adaptable to specific rail networks and that an optimum guidance of the wheel set often cannot be achieved. This problem occurs in particular in bogies that have to run in different networks with a specific portion of highly demanding tracks having, for example, narrow curves. A guidance assembly that is not optimised can cause undesirable wear of the wheels, noise, passenger discomfort because of undesired movements of the car body, and more importantly a risk of derailment.

A further problem of the prior art wheel guidance assemblies is that the rail tracking forces that occur during driving, in particular on curved tracks, are for a large part carried by the longitudinal beams of the bogie frame. These beams keep the wheel set

guidance elements, spring, dampers and ther components in position. The stiffness of the bogie frame must be designed to accommodate such forces. Prior art bogie frames, designed for use in a variety of situations, are typically over-designed to meet all stiffness requirements and are hence undesirably heavy.

Accordingly, there is a need for an improved wheel set guidance assembly. Preferably, such an improved assembly would be compact, to allow for a low bogie construction and a low car body floor.

According to the present invention there is provided a wheel set guidance assembly comprising individual vertical-, lateral and longitudinal guidance elements for independent guidance of the movement of the wheel set in vertical, lateral and longitudinal directions, wherein the stiffness of the guidance elements can be selected independently of each other.

In contrast to the known guidance assemblies, the assembly of the present invention offers a comprehensive scheme of wheel set guidance means, which can easily be adapted to the specific circumstances and needs of different rail networks. Thus an optimum running behaviour with regard to safety, comfort and wear can easily be achieved covering a wide range of operating conditions with the same basic bogie arrangement. It has been found that the wheel set guidance assembly according to the present invention can meet the high requirements for stability and curve guidance, as well as for safety against derailing over a wide range of applications of the bogie.

An embodiment of the guidance assembly of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG.1 is a schematic representation of a bogie comprising one embodiment of a wheel set guidance assembly according to the present invention; and

FIG.2 is a schematic representation of a single wheel set guidance assembly of the embodiment of Figure 1 in partial cross-section and showing the vertical and lateral guidance elements.

In Figure 1 and 2 a preferred embodiment of the wheel set guidance assembly of the present invention is shown, located in a bogie for a rail vehicle. Referring to Figure 1, a rail bogie has a bogie frame (30) of largely conventional design. The bogie frame (30) is supported at each end by a wheel set assembly. The two wheel set assemblies shown are identical. For clarity and ease of reference the details of just one assembly is shown in Figure 2 and described hereafter. The wheel set comprises a pair of wheels mounted on either end of an axle (not shown) in conventional manner and running on a set of rails (not shown). Each end of the axle runs in a wheel set bearing (10) suspended by a wheel set guidance. The wheel set bearing shown has a housing shaped with horizontal extensions in longitudinal direction on both sides of the axle position to support the lower end of the springs (50) and means for attaching the longitudinal and lateral guidance elements (not shown).

In Figure 1, a longitudinally arranged wheel set linkage bar (40) acts as a longitudinal guidance element and flexibly connects the bogie frame (30) and the wheel set bearing (10) to allow guidance of a turning movement of the wheel set (20) on curved tracks. The longitudinal linkage bar (40) has a length extending towards a centre bogie console (100) in the longitudinal centre position of the bogie frame (30). With centre bogie console is meant a centre part of the bogie provided with protruding connection means for both sides of the bogie. The wheel set linkage bar (40) is preferably connected to the longitudinal inward position of the wheel set bearing with flexible couplings on either side, preferably spherical couplings, for example spherical rubber couplings to provide bias. The bar itself preferably is rigid. The length of the longitudinal linkage bar (40) is preferably more than half, more preferably more than 75% of the distance between the wheel set axle position and the bogie centre position. The advantage is that undesired movements of the linkages are reduced and that the longitudinal guidance forces do not have to be transmitted via the bogie frame. Preferably the wheel set

linkage bar (40) is connected at about the height of the wheel set axle (21) extending essentially horizontally to connect to the centre bogie console (100).

In Fig.1 the lateral guidance element is a spring element (60) of anisotropic stiffness engaging a guidance pin (70). As used herein, "anisotropic stiffness" is a reference to the stiffness in lateral direction being higher than the stiffness in both other perpendicular directions. The anisotropy ratio, i.e. the stiffness in lateral direction over the stiffness in the longitudinal direction can be as little as 1.1, but more often is more than 2 or even 5, depending on the specific requirements of the track.

As shown in Fig. 1, the guidance pin (70) can be rigidly mounted in the bogie frame protruding in the spring element (60) mounted on the wheel set bearing (10). In an alternative embodiment the guidance pin (70) is rigidly mounted on the wheel set bearing (10) protruding in the spring element (60) rigidly mounted in the bogie frame (30). In operation, the lateral forces generated by the lateral movement of the wheel set along curved tracks are transferred by the guidance pin (70) guided via the spring element (60) from the wheel set bearing to the bogie frame or visa versa.

The spring element (60) can be any resilient element for example a rubber-metal element with different shape or composition in lateral and longitudinal direction. Preferably, the spring element (60) comprises a rubber-metal element, for example an arcuate block having alternating rubber and metal plates, arranged in lateral direction only, thus ensuring a very low stiffness in longitudinal and vertical direction and a high stiffness in lateral direction.

The guidance in lateral direction remains substantially separate and can be chosen independently from the guidance in vertical and longitudinal directions. In the combination of a longitudinal linkage bar and anisotropic lateral guidance element as described above the stiffness in longitudinal direction can be chosen completely independently from the stiffness in lateral direction. The lateral guidance can easily be

adjusted by choosing the anisotropy and stiffness of the spring element (60) in view of the specific circumstances of the track.

The vertical guidance element shown in Figure 1 and 2 is a vertically arranged coil spring (50) connecting the wheel set bearing (10) and the bogie frame (30). The coil spring (50) can be arranged in different ways. A single coil spring can for example be arranged on top of the wheel set bearing centred above the wheel set shaft (21). As shown in Fig. 1 and Fig. 2 the wheel set guidance preferably has two coil springs (50) on each side in longitudinal direction of the wheel set bearing and arranged next to the axle position. The lower end of the coil springs on both sides of the axle position of the wheel set bearing are preferably arranged below the level of the wheel centre, preferably lower than the axle bearing. The wheel set bearing has a housing shaped with horizontal extensions in longitudinal direction on both sides of the axle position to support the lower end of the springs. The advantage of this embodiment is that the wheel set guidance is much more compact in vertical direction allowing a lower car body floor.

The spring element (60) of anisotropic stiffness is preferably arranged above, in or below the coil spring (50) engaging the guidance pin (70) positioned inside said coil spring as shown in Figure 2. This has the advantage of a very low construction volume.

A further advantage of the wheel set guidance having two springs is that it is possible to combine one or two lateral guidance element with the coil springs. This possibility creates a further easy and flexible possibility to optimise the wheel set guidance assembly to the requirements of a specific track. The embodiment shown in Fig. 1 and 2 comprises two coil springs both comprising a lateral guidance element. In another embodiment of the invention the wheel set guidance has only one of the two coil springs (50) combined with a lateral guidance element comprising a spring element (60) of anisotropic stiffness positioned below, in or above the coil spring and engaging a guidance pin (70) positioned inside the coil spring. Preferably this is the longitudinally inward coil spring. The use of just one guidance pin for each wheel set bearing, in combination with the connection to the bogie centre through the wheel set linkage bar,

creates an additional virtual lever on the turning momentum of the wheel sets during travel in curved tracks, giving advantageous support due to aligning forces.

In a preferred embodiment of the present invention the wheel set guidance assembly has, as the longitudinal guidance element, a longitudinally arranged wheel set linkage bar (40) for connecting the bogie frame (30) and the wheel set bearing (10) flexibly to allow guidance of a turning movement of the wheel set on curved tracks, wherein the longitudinal linkage bar (40) has a length extending towards a centre bogie console (100) in the longitudinal centre position of the bogie frame (30) and, as the vertical guidance element, at least one vertically arranged coil spring (50) connecting the wheel set bearing (10) and the bogie frame (30) and, as the lateral guidance element, a spring element (60) of anisotropic stiffness engaging a guidance pin (70). Preferences for the guidance elements are described above. This embodiment has the advantage of a simple, mutually independent choice of the rigidities in each direction easily adaptable to the specific requirements of the trajectory to be driven on.

In a most preferred embodiment, the wheel set guidance further has two coil springs (50) on each side (in longitudinal direction) of the wheel set bearing with the lower ends of both spring coils being below the wheel set axle level and the upper ends supporting the bogie frame (30) and wherein the lateral guidance element is a spring element (60) engaging a guidance pin (70) both rigidly mounted opposite to each other on either the bogie frame or the wheel set bearing and arranged on, in or below one or both coil spring (50). This embodiment has the additional advantage of having a low car body floor.

The invention further relates to a bogie comprising a wheel set guidance assembly as described above. Preferably, the bogie comprises two wheel sets both provided on both sides with a wheel set guidance assembly as described above. The wheel set guidance assembly is preferably used in combination with dampers to smooth and decelerate movements between the bogie and the wheel set and between the car body and the bogie. The bogie preferably comprises primary damping, for example dampers (80),

connecting the wheel set bearing (10) to the bogie frame (30). Preferably the bogie further comprises yaw dampers (90) connecting on one end the centre bogie console (100) and on the other end (120) to the car body. The bogie can further comprise further functional elements, for example a secondary suspension (110) of the car body, brakes, traction power transmission elements and drive equipment.

The invention further relates to a method for providing a bogie with optimal wheel set guidance comprising the steps of providing a bogie comprising a wheel set guidance assembly comprising individual vertical-, lateral and longitudinal guidance elements, preferably a wheel set guidance according to the invention as described above, and selecting the stiffness of each guidance element in vertical, lateral and longitudinal directions independently of the stiffness of the other guidance elements to optimise the wheel set guidance in view of the requirements of a particular application of the bogie. The advantage of the method is that is more easy and inexpensive to adapt the same bogie to meet the specific wheel guidance requirements of a wider variety of different tracks.

CLAIMS

1. Wheel set guidance assembly for suspending a wheel set bearing (10) of a wheel set (20) to a bogie frame (30), comprising individual vertical-, lateral and longitudinal guidance elements for independent guidance of the movement of the wheel set in vertical, lateral and longitudinal directions wherein the stiffness of each guidance element can be selected independently of the other guidance elements.

2. Wheel set guidance assembly according to claim 1, wherein the longitudinal guidance element is a longitudinally arranged wheel set linkage bar (40) for connecting the bogie frame (30) and the wheel set bearing (10) flexibly to allow guidance of a turning movement of the wheel set on curved tracks, wherein the longitudinal linkage bar (40) has a length extending towards a centre bogie console (100) in the longitudinal centre position of the bogie frame (30).

3. Wheel set guidance assembly according to claim 2, wherein the wheel set linkage bar (40) is connected to the longitudinal inward position of the wheel set bearing (10) with a flexible coupling.

4. Wheel set guidance assembly according to claims 2 or 3, wherein the wheel set linkage bar (40) is flexibly connected at about the height of the wheel set axle extending essentially horizontally to flexibly connect to the centre bogie console (100).

5. Wheel set guidance assembly according to claims 1 - 4, wherein the lateral guidance element is a spring element (60) of anisotropic stiffness engaging a guidance pin (70).

6. Wheel set guidance assembly according to claim 5, wherein the stiffness of the spring element (60) in the lateral direction is higher than the stiffness in the longitudinal and vertical direction.

7. Wheel set guidance assembly according to claim 6, wherein the spring element (60) comprises rubber-metal elements arranged in lateral direction only.

8. Wheel set guidance assembly according to claims 5 - 7, wherein the guidance pin (70) is rigidly mounted in the bogie frame (30) protruding in the spring element (60) rigidly mounted on the wheel set bearing (10).

9. Wheel set guidance assembly according to claims 5 - 7, wherein the guidance pin (70) is rigidly mounted on the wheel set bearing (10) protruding in the spring element (60) rigidly mounted in the bogie frame (30)

10. Wheel set guidance assembly according to claims 1 - 9, wherein the vertical guidance element is at least one vertically arranged coil spring (50) connecting the wheel set bearing (10) and the bogie frame (30).

11. Wheel set guidance assembly according to claim 10, having two coil springs (50) on each side in longitudinal direction of the wheel set bearing and arranged next to the axle position

12. Wheel set guidance assembly according to claim 10 or 11, wherein one or both coil springs (50) are combined with a lateral guidance element comprising a spring element (60) of anisotropic stiffness positioned below, in or above the coil spring and engaging a guidance pin (70) positioned inside the coil spring.

13. Wheel set guidance assembly according to claim 1, wherein

- the longitudinal guidance element is a longitudinally arranged wheel set linkage bar (40) for connecting the bogie frame (30) and the wheel set bearing (10) flexibly to allow guidance of a turning movement of the wheel set on curved tracks, wherein the longitudinal linkage bar (40) has a length extending towards a centre bogie console (100) in the longitudinal centre position of the bogie frame (30), wherein

- the vertical guidance element is at least one vertically arranged coil spring (50) connecting the wheel set bearing (10) and the bogie frame (30) and wherein the lateral guidance element is a spring element (60) of anisotropic stiffness engaging a guidance pin (70).

14. A wheel set guidance assembly substantially as hereinbefore described having reference to Figures 1 and 2.

15. A bogie comprising a wheel set guidance assembly as defined in any one of claims 1 - 14.

16. The bogie according to claim 15 comprising two wheel sets both provided with a wheel set guidance assembly according to any one of claims 1 - 14.

17. A bogie substantially as hereinbefore described having reference to Figures 1 and 2.

18. A method for providing a bogie with optimal wheel set guidance comprising the steps of:
- providing a bogie comprising a wheel set guidance assembly comprising individual vertical-, lateral and longitudinal guidance elements and
- selecting the stiffness of each guidance element in vertical, lateral and longitudinal directions independently of the stiffness of the other guidance elements to optimise the wheel set guidance in view of the requirements of a particular application of the bogie.

19. The method according to claim 18, wherein the wheel set guidance assembly is the wheel set guidance assembly according to claims 1 – 14.

20. A method for guiding a wheel set of a bogie substantially as hereinbefore described having reference to the accompanying drawings.

ABSTRACT

A wheel set guidance assembly is provided for suspending a wheel set bearing (10) of a wheel set (20) to a bogie frame (30), comprising separate vertical (50), lateral (70) and longitudinal (40) guidance elements for independent guidance of the movement of the wheel set in vertical, lateral and longitudinal directions wherein the stiffness of the guidance elements can be selected independently of each other.

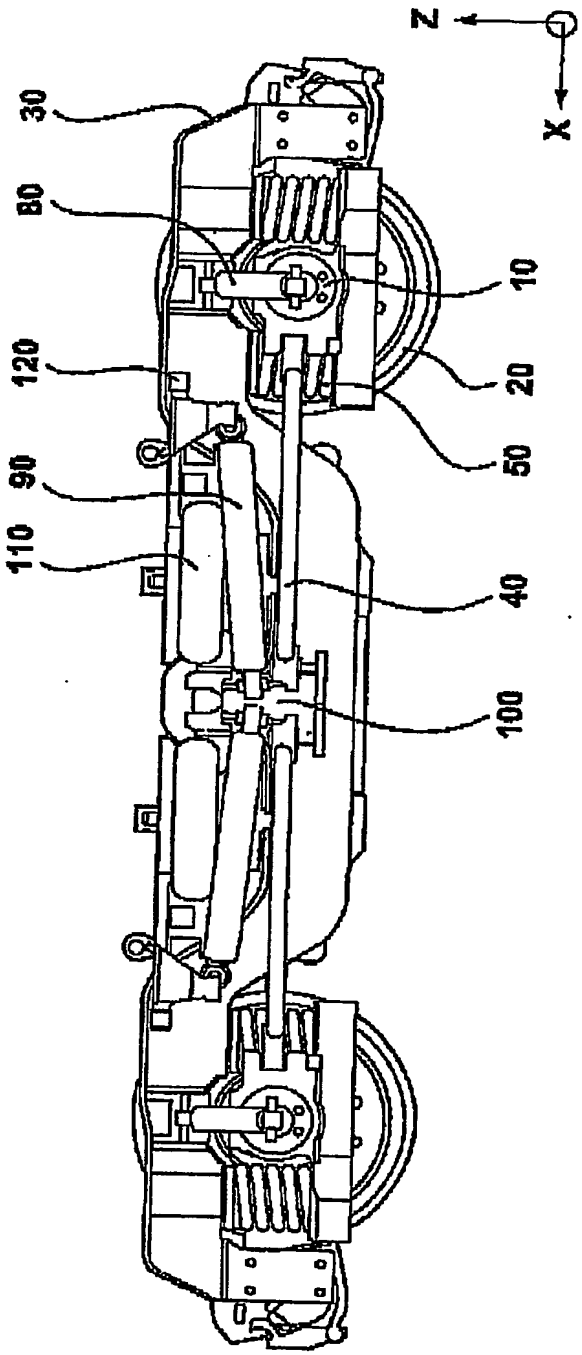


Figure 1

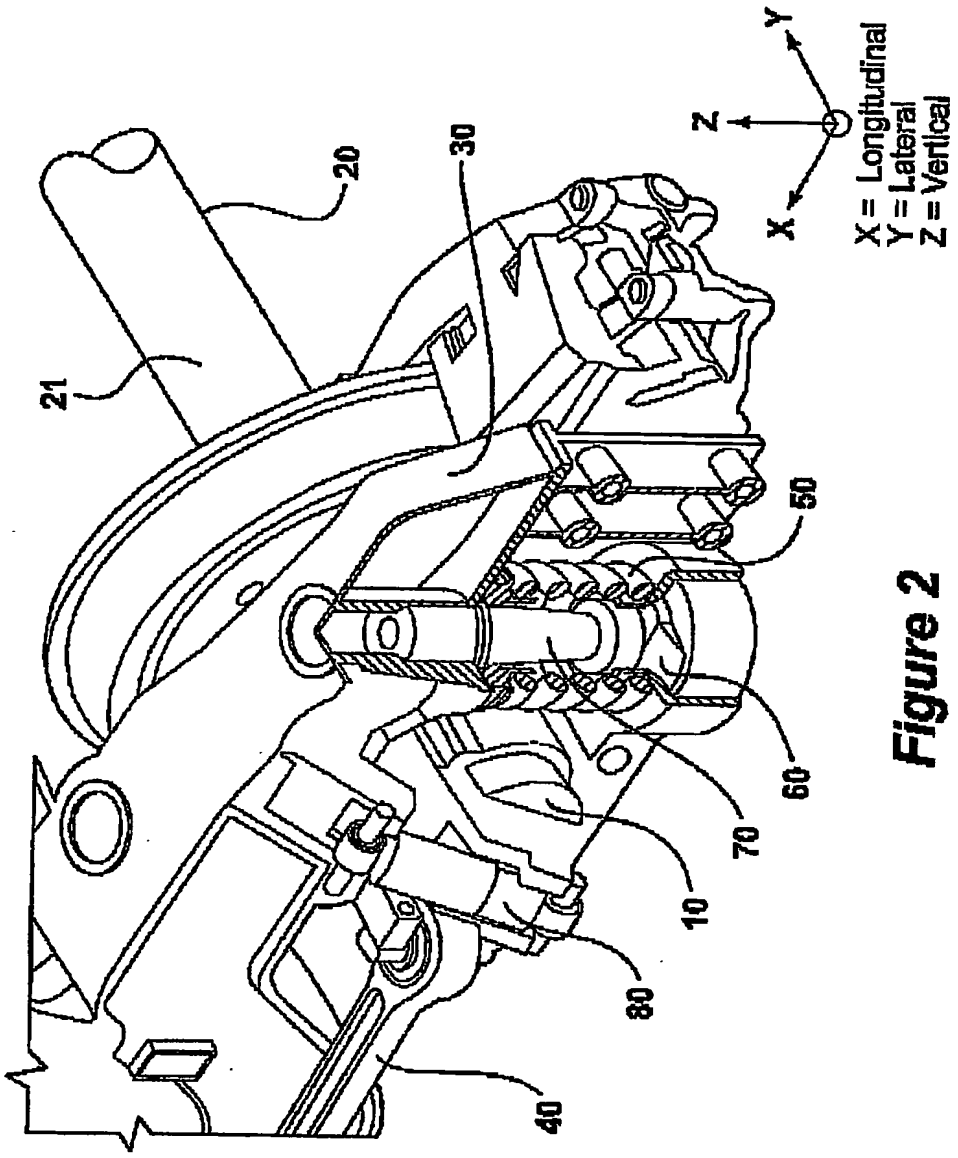

Y
Z
X
X = Longitudinal
Y = Lateral
Z = Vertical
20
30
21
50
60
70
10
80
40

Figure 2

Recall madrid. Fax. 00 34 91 8791676; Email: ribatejada.archivos@recall.com

W. F1533.

From: **9250 EPO TH**

[X] ORIGINAL

[ ] DIGITAL IMAGE

[ ] photocopy

84 00324689

BOX nr.:	15-09-2004 12
Batch nr.:	MU10-09-2004 0002
PXI doc's:	E2EP 03141590WP1
DOC code:	~~RO-LETT~~ PCT2LETT + PRIODOC

Requested by:

Coen Hamm,
room: S00G12
e-mail: chamm@epo.org

To be send to the same

BY: **DHL**

Via: Postroom

pls use this adress:

European Patent Office DG1
Phoenix Supportdesk Room S 00 G 12
Patentlaan 2
2280 HV Rijswijk (ZH)
The Netherlands

Comments: Pls. copies in box.

For EPO use:

Date request send:	09-06-05
Date request finished:	
Number of pages concerned:	11

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/EP03/014159

International filing date: 12 December 2003 (12.12.2003)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0229046.8
Filing date: 13 December 2002 (13.12.2002)

Date of receipt at the International Bureau: 09 September 2004 (09.09.2004)

Remark: Priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse